



Case report

Spinal Diastematomyelia: A means of identification of charred remains



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ABSTRACT

The purpose of medico legal autopsy examination is the positive identification of the deceased in addition to the determination of the cause of death in most jurisdictions and additionally the manner of death in many jurisdictions. Notwithstanding the established and recognised value of DNA analysis in human identification, in the case of significant and extensive thermal injury in victims of fire, DNA analysis may prove difficult. Fire fatality identification can be assisted by alternative methods in this situation, including correlation between ante mortem and post mortem radiological investigations, identification of rare medical disease and or dental record examinations, where available. We describe a case where identification of charred human remains from a car fire was securely determined by demonstration of the presence of a rare congenital abnormality of the spinal cord, Diastematomyelia.

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1. Introduction

The roles of the medico legal autopsy examination in cases of deaths in a fire involve both determination of manner and cause of death and the positive identification of the deceased. Identification of the deceased can prove particularly challenging in cases where extensive thermal injury precludes accurate DNA analysis. In such cases, and in cases where identification requires cheaper or faster methodologies, various ancillary methods of identification can be employed including post mortem radiology with comparison to pre-mortem studies, dental record examination, identification of pre-mortem medical conditions and examination of the scene and personal effects.^{1,4,5} We report one such case, where the post mortem demonstration of a rare congenital spinal abnormality, Diastematomyelia, with comparative pre-mortem and post-mortem imaging studies, allowed accurate identification of a victim of a car fire.

2. Case report

A charred body was discovered by law enforcement agents in an abandoned burnt out car. This unnatural scene raised suspicion, requiring careful and detailed investigation. The services of the Office of the State Pathologist were requested to assist in the investigation of this unnatural death scene, through the identification of the deceased and the determination of the cause of death.

Examination of the scene revealed an extensively charred female body in a reclined driver's seat of a burnt out car, in a remote scenic location (Fig. 1). The skeletal structures appeared carbonized and significant charring of soft tissue was identified. The upper extremities showed fractures and disarticulation of hands and feet. Although the vault of the skull appeared relatively intact, it exhibited egg shell fracture pattern covering the anterior half and the vault was diffusely blackened on the posterior half. The mandible and maxilla were significantly and partially damaged respectively, with fractures and blackening of limited residual teeth. Several internal organs were exposed and thermally damaged to varying extents. This was due to significant soft tissue damage of the anterior trunk.

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Fig. 1. Charred remains were discovered in a burnt out car.



Fig. 2. Dissection of the spinal cord revealed a bifid cord seen here in situ.

The body was carefully extricated and placed in a plastic bag which was then sealed. The remains were transferred to the hospital for pre-autopsy full body Computed Tomography (CT) scan imaging. Post mortem CT scanning was performed on a Philips Brilliance 64 scanner with kV 120, mA 156, scan thickness was 1 mm, and it was reconstructed on a standard bone algorithm.

Pre-autopsy CT imaging, reported by a clinical radiologist, revealed an unusual spinal abnormality in addition to bilateral hip prostheses. Post-mortem dissection revealed a bifurcation of the spinal cord was demonstrated at the level of the second and third lumbar vertebrae (Figs. 2 and 3). This bifurcation was associated with a bony spur extending from the anterior spinous process of L2 (Fig. 4). Both spinal cord tracts were surrounded by separate dural sacs. These findings suggested a diagnosis of type 1 Diastematomyelia, a rare congenital spinal cord abnormality. This diagnosis was confirmed by neuropathological examination. Bilateral hip prostheses were also documented at the time of post mortem.

Preliminary police investigation of the car led to a report of a missing person, a 56 year old female, resident of the area, with a chronic history of back pain associated with a congenital history of spina bifida occulta and bilateral hip prostheses. The post mortem imaging studies were compared to an ante mortem imaging in this individual. She had undergone investigation of back pain five years previously and in the course of that investigation Magnetic Resonance Imaging (MRI) was performed which had provided the diagnosis of Diastematomyelia. This MRI was performed in the same institution as the post mortem imaging. The persistence of this radiological abnormality over a five year period serves to highlight the utility of demonstration of osseous malformations in the identification of unknown individuals given the stability of these lesions over time. The radiological abnormality was also demonstrated on a pre mortem CT, carried out three months before her death (Fig. 5).

The demonstration of the unique finding of a rare spinal cord congenital malformation in addition to bilateral hip prostheses which correlated with documented pre mortem imaging proved definitively adequate to allow identification of the deceased.

The post mortem imaging ruled out evidence of firearm related fatality. Subsequent autopsy examination ruled out evidence of sharp force trauma involving the internal organs. There was no evidence of visceral natural diseases that could be identified macroscopically or microscopically. Subsequently, a note left by the

decedent was discovered by her family expressing regret for her action.

This is the first reported case of post mortem identification of an individual by means of demonstration of Diastematomyelia.

3. Discussion

Deaths secondary to fires remain a leading cause of death worldwide.¹ Although the majority are accidental, approximately 10% result from a fire that was started deliberately and as such all fire deaths are treated as suspicious and are investigated.⁴ This is particularly true in cases of fire deaths in a car as self immolation in this setting is rare.⁵

Depending on the severity and extent of the thermal injury the identification of the deceased following a fire involves several investigative modalities including; comparative radiology, detailed circumstantial history gathering, comparison of odontology records and prior medical history with those of potentially suspected decedents, recovery of personal effects, DNA analysis of sampled tissue and detailed autopsy examination despite the apparent loss of most of the commonly recognisable external features.^{2,3}

The most accurate means of identification is by DNA typing using autosomal and Y-chromosomal short tandem repeat (Y-STR) markers. Mitochondrial DNA sequencing has been applied to teeth, bones and hair which contain low concentration of degraded DNA and would be unsuitable for nuclear DNA.⁶

The DNA methodology is high in cost and takes time, although improved technological advances appear to reduce the turn-



Fig. 3. Bifid cord demonstrated following dissection.



Fig. 4. The overlying transverse spinal process demonstrated a bony spur which correlated to the site of spinal cord bifurcation.

around time.⁷ In severely charred cases appropriate tissue samples may not be available and the quality of retrieved DNA concentration may be compromised.

Another commonly employed method of identification in this situation is through comparative odontology studies using post-mortem dental imaging and pre-mortem dental records.^{8,9} Severely charred bodies often pose a particular problem in dental examination because of the increased fragility of heat damaged mandible and or maxilla with resultant multifocal fractures, teeth displacements and loss, and teeth becoming too brittle and fragile to handle, thus seriously impeding comparative dental analysis. The manipulation of the body may compound and or result in further loss.¹⁰

If personal effects such as clothing or jewellery are discovered at the scene or on the body this may assist in identification, particularly if they can be compared to those of a reported known missing individual.¹¹ Often clothing on the body is burnt extensively and beyond recognition. On occasion residual friable and damaged fragments are recovered which may prove forensically important. Metal jewellery, whenever available, will withstand most of the heat generated in a car fire and can be of evidentiary value in facilitating the process of identification.

Crime scene evidence may also be of assistance. For instance the chassis number of a burnt out car can be traced to the registered owner of the car. In fact this assisted in identification of the deceased in this case. This is however circumstantial evidence in

terms of identification and must be interpreted with caution, particularly in cases of suspected foul play.

Identification of a charred body can in certain cases be assisted by post mortem radiology. Whole body imaging, either plain film or CT, is performed prior to dissection of the body. This allows visualisation of predominantly osteo-articular abnormalities that may be unique to the individual. The radiologic identification of individual human remains depends entirely on matching specific and unique visual findings or features on both ante-mortem and post-mortem radiologic images of that person.¹² In most cases this involves documentation of known healed fractures, surgical interventions or prostheses. These findings again are circumstantial however if there is a clearly documented pre-mortem history with comparative imaging and if the abnormality in itself is rare in the general population it can provide strong corroborative evidence of victim identification.¹²

In this case the finding of Diastematomyelia, a rare spinal cord congenital abnormality, along with bilateral hip prostheses, facilitated positive identification of the deceased.

Diastematomyelia is a rare congenital abnormality of the spine, belonging to the group of occult spinal dysraphisms, where the spinal cord divides into two hemicords.^{13,14} It was originally described in 1837 by C.P. Ollivier who coined the term Diastematomyelia. It has since been re designated as split cord malformation (SCM) by Pang et al.,¹⁵ who also described its sub classification. This spinal abnormality occurs in utero between days 15 and 18 gestation. It is thought to result from incorrect development of the notochord.^{15–17}

Diastematomyelia can be sub classified into two types. Type I Diastematomyelia consists of two hemicords, each contained within its own dural tube and separated by a rigid osseocartilaginous midline septum. Type II consists of two hemicords housed in a single dural tube separated by a non-rigid, fibrous median septum.¹⁵

Diastematomyelia may occur in isolation, as in the case we describe, or may be associated with spinal abnormalities such as myelomeningocele, meningocele, spinal lipoma, neuroenteric cysts or dermal sinus, as well as congenital defects of the spine, including hemivertebrae, butterfly vertebrae, and scoliosis.¹⁴ There may also be accompanying visceral abnormalities, most commonly involving the kidneys, anus or reproductive organs.¹⁸

Diastematomyelia is usually diagnosed in the prenatal period by ultrasound or magnetic resonance imaging.^{13–15} Most patients are diagnosed before the age of seven.¹⁴ Adult presentation, as was the case with our patient, although rare, has been reported.¹⁴ It is usually an isolated asymptomatic phenomenon and has a good functional outcome.¹⁹

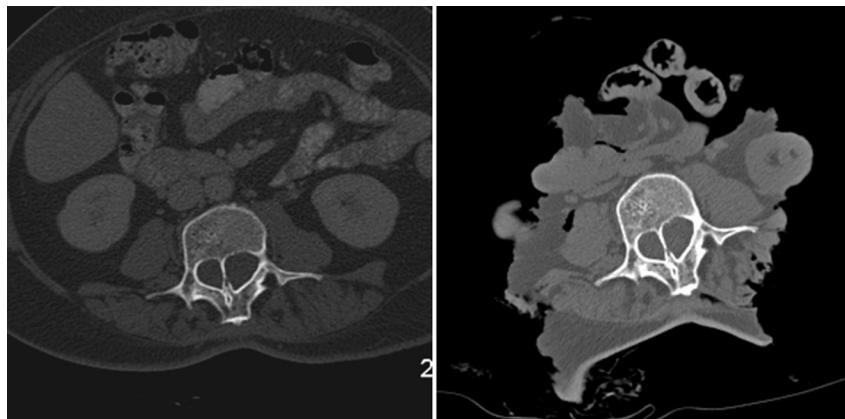


Fig. 5. Comparative pre mortem (right) and post mortem (left) CT imaging demonstrating the duplicate spinal canal.

In adult cases surgery is advocated only if there is stenosis or cord tethering resulting in neurological deficit. Prophylactic spur removal is not recommended in asymptomatic cases unless scoliosis surgery is planned.^{19,20}

4. Conclusion

Victim identification following a fire may present difficulties. Identification of rare congenital anatomical anomalies can assist in this process. We report the first case of victim identification following a fire based on the demonstration of a rare spinal congenital anomaly, Diastematomyelia.

Ethical approval

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Conflict of interest

None.

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